APRIL 1964

XV-5A

LIFT FAN FLIGHT RESEARCH AIRCRAFT PROGRAM

CONTRACT NUMBER DA44-177-TC-715

GENERAL ELECTRIC

XV-5A LIFT FAN
FLIGHT RESEARCH AIRCRAFT

Contract No. DA44-177-TC-715

QUARTERLY TECHNICAL PROGRESS REPORT NO. 9
For Period November 16, 1963 to February 15, 1964

ADVANCED ENGINE AND TECHNOLOGY DEPARTMENT
GENERAL ELECTRIC COMPANY
Cincinnati 15, Ohio

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I. SUMMARY

During the ninth quarter (November 16, 1963 to February 15, 1964) progress under the propulsion system program included:

* Seven technical program reports completed and transmitted to TRECOM with the remaining data necessary for low speed flight clearance nearing completion.
* Revision to Maintenance Manual completed.
* Propulsion system spare parts, quantities, price control, and authority for use established with TRECOM.
* Spare J85 engines, one lift fan, one pitch fan, plus engine and fan spare components packaged for shipment to Edwards.
* Provided propulsion system support during aircraft ground tests.
* Preparation for full scale wind tunnel test was completed in terms of detail test plan, instrumentation, test fixtures, and data reduction program.

II. DESIGN AND ENGINEERING

A. SPECIFICATIONS AND REPORTS

During the reporting period, seven technical reports were completed and transmitted to TRECOM. The subjects included such areas as detail ground test procedures, scale model wind tunnel results, structural analysis of airframe components, plus details of the full scale wind tunnel test plan. An additional seven reports are being processed for submittal leading to a request for low speed flight clearance early in the next quarter.

A flight test organization chart (Fig. 1) plus a V_n diagram defining the planned flight test points (Fig. 2) are being prepared for transmittal to TRECOM for approval. Upon receiving this acknowledgment, the Detailed Flight Test Plan, Report 129, will be considered approved.

B. AIRPLANE SUPPORT

1. Ejection Seat - North American LW-2

Although not an actual part of the XV-5A program, one additional LW-2 ejection seat firing was witnessed at North American, Columbus. This test, part of the demonstration program for another airframe application, was "through the canopy" at ground height and zero forward velocity. The simulated cockpit incorporated side-by-side seating and included both windshield and canopy. A 95 per centile dummy was used for this test and was installed on the right hand side of the cockpit. All systems functioned properly resulting in a successful recovery.

Of prime significance to the XV-5A program is the fact that the fore, aft, and vertical clearance in this configuration is less than the XV-5A cockpit. Dummy contact during the test was limited to the knees and helmet top.

This most recent firing was accomplished with a seat incorpo-

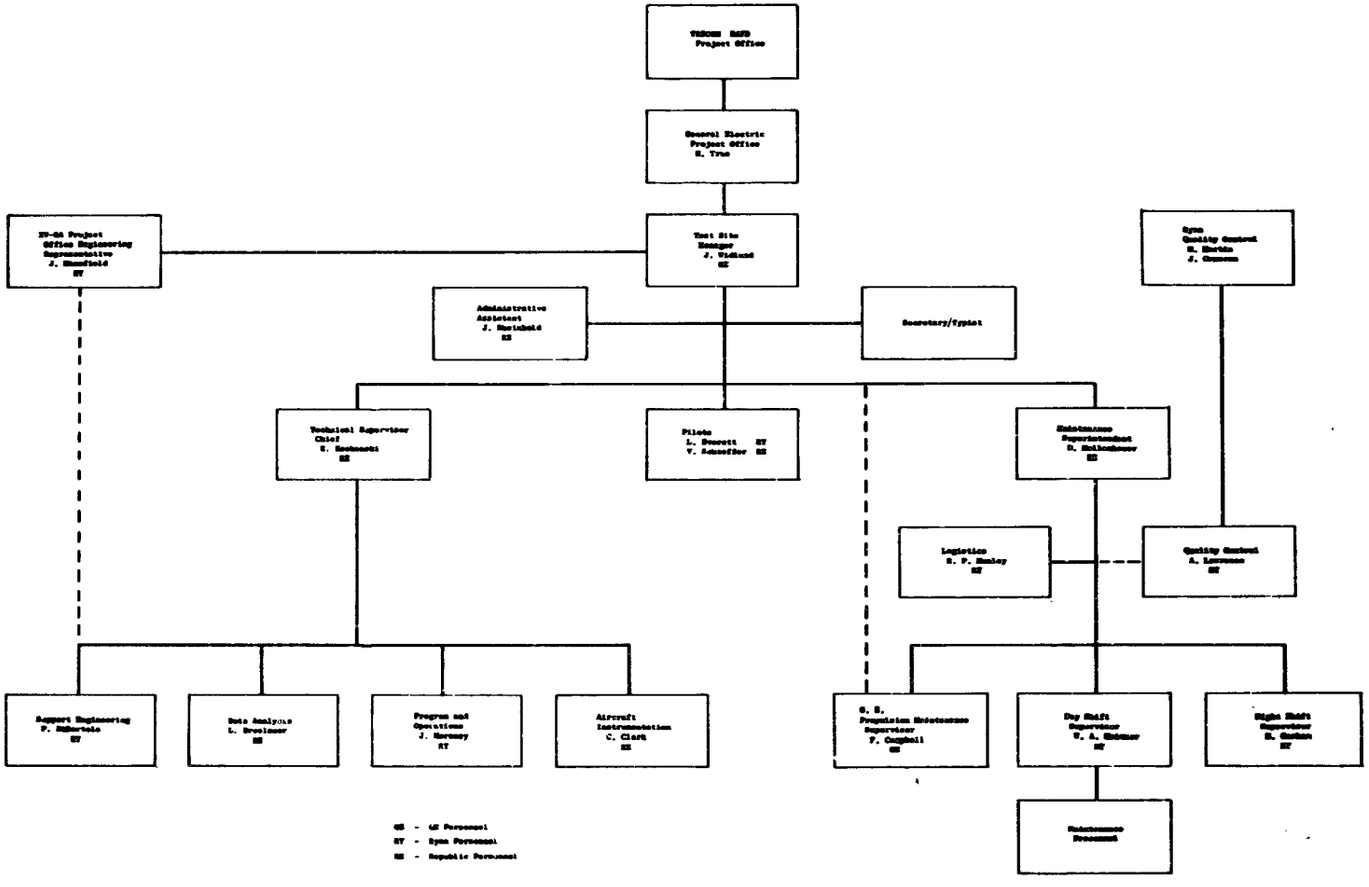

Figure 1. XV-5A Flight Test Organization at Edwards Air Force Base

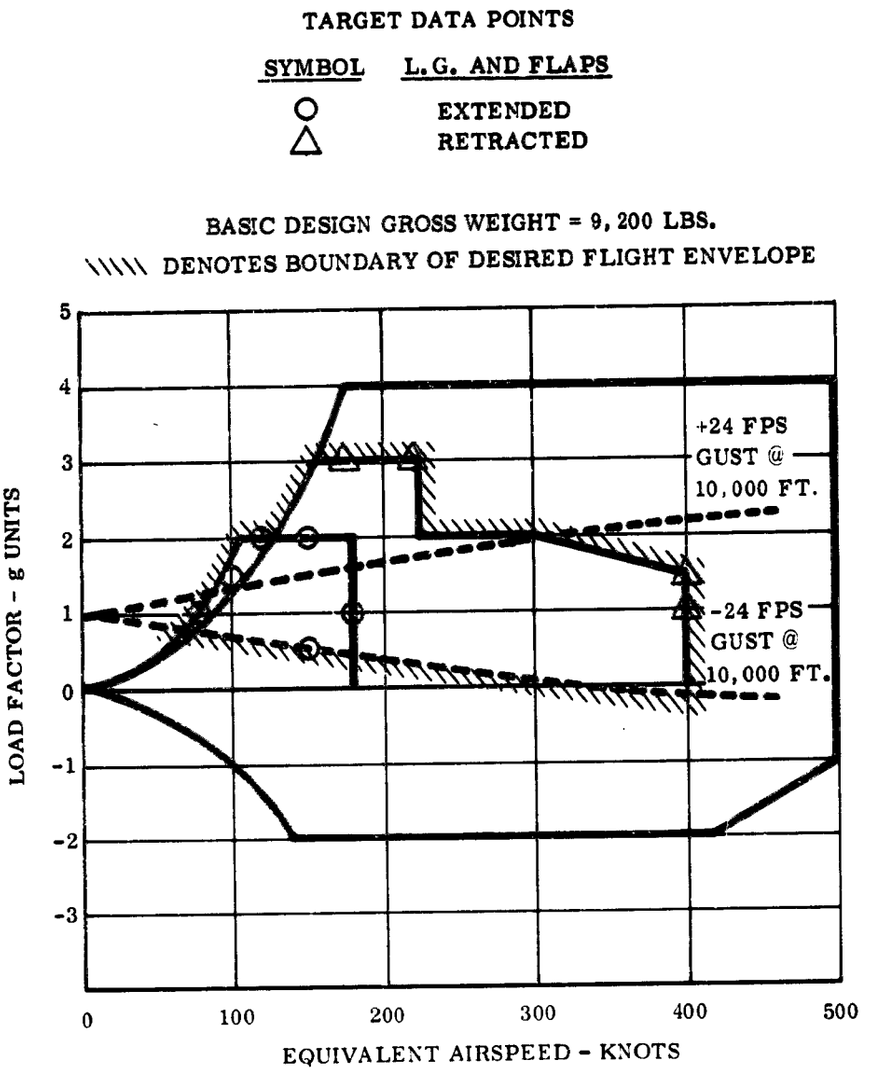

Figure 2. Maneuvering Envelope - Gust Diagram for Altitudes Below 10,000 Feet

rating all of the recommended modifications. TRECOM had been requested to permit modification of LW-2 seats presently at Edwards. This request has now been approved. Work to incorporate a shortened harness release handle, plus replacement of a harness Adel pin with a bolt, will be accomplished at the Edwards test site during the next reporting period.

A two-day briefing and education session for LW-2 seat familiarization was held at Ryan during this period. A North American, Columbus, technical representative reviewed the installation, inspection, and maintenance of the seat for General Electric, Republic, and Ryan maintenance, flight, and supervisory personnel. A further check of the seat after it is armed and ready for use at Edwards has been requested of North American.

III. MANUFACTURE AND FLIGHTWORTHINESS TEST

A. LIFT AND PITCH FAN STATUS

Fan status, by serial number, is as follows:

Lift Fans

003L FWT vehicle, at General Electric, Evendale, removed from test facility, being prepared for Government acceptance. (Program spare).

004R Installed in #2 aircraft; 1:42 hours operation with 0:45 hours above 65% speed.

005L Installed in $1 aircraft; no operation since delivery.

006R Installed in #1 aircraft.

007L Installed in #2 aircraft; 1:42 hours operation with 0:45 hours above 65% speed.

008R Program spare, at Edwards Air Force Base.

Pitch Fans

001 FWT vehicle, program spare, at Edwards Air Force Base.

002 Installed in #1 aircraft.

003 Installed in #2 aircraft; 1:42 hours operation; 0:45 hours above 65% speed.

B. GOVERNMENT FURNISHED EQUIPMENT

1. YJ 85 Engines

There has been no change in the status of the YJ 85 engines at the end of the reporting period. Engines S/N 230-729 and 730 were removed from aircraft 62-4506, shipped to Edwards AFB, inspected for overtemperature conditions, rebuilt, and reinstalled in the aircraft. No evidence of damage was seen as a result of the December 29 incident involving the observed overtemperature engine operation.

Two new J85 engines, S/N 231-231 and 232 were shipped to the Ryan plant in San Diego as possible replacement units in aircraft #2.

Since these engines were not used, they will be shipped to Edwards AFB as spares support.

Engine S/N 231-230 and 232 were shipped during the reporting period to Edwards AFB. Installation of firewalls will be accomplished during the next quarter on these two units for support of both the flight and full scale wind tunnel tests.

C. MAINTENANCE MANUAL

Revisions to the Propulsion System Maintenance Manual were completed during this period. The revised edition is being reproduced for distribution early in the next reporting period.

D. SPARE PARTS

A list of propulsion system spare parts that will be stocked at Edwards AFB was submitted to TRECOM. Agreement was reached that these parts and quantities should be adequate for successful completion of the initial flight test demonstration program. Methods of price control and authority for spares usage were also established.

Two J85 engines, spare J85 components, one lift fan, one pitch fan, plus fan spare components were packaged in preparation for shipment to Edwards AFB. An adequate storage area and a means of issue control and inventory has been established at the flight test facility.

TABLE I J85 RUNNING RECORD

Engine S/N	Location	Prior (Hrs.)	Since P.I. (Hrs.)	Ryan (Hrs.)	Status
230-729	Ryan	79:16*	8:43	6:54	Installed in #2 aircraft
-730	Ryan	80:40*	10:18	7:34	Installed in #2 aircraft.
-875	Ryan	--	1:04	1:04	Installed in #1 aircraft.
-876	Ryan	--	1:01	1:01	Installed in #1 aircraft.
231-230	Edwards	0	0	0	-5A configuration - new
-231	Ryan	0	0	0	-5A configuration - new
-232	Ryan	0	0	0	-5A configuration - new
-233	Edwards	0	0	0	-5A configuration - new

* Includes running time from flightworthiness test

IV. AIRCRAFT GROUND TEST SUPPORT

A. INSTALLED SYSTEMS TESTING

Propulsion system functional tests were initiated on #2 aircraft during the reporting period and were 95% complete at the close of the period. Purpose of the propulsion system operation was: (1) functionally check for leakage in the air, hydraulic, lubrication, or fuel systems; 2) verify design integrity of ducts, inlet and exit fan closures, thrust spoilers, engine control systems, and cooling systems for the aircraft and propulsion system; plus (3) provide pilot familiarization with the aircraft propulsion system controls, both normal and emergency systems, and with propulsion system response.

During these propulsion system tests, a fire and J85 overtemperature condition was experienced in the #2 aircraft on December 29, 1963. Extensive effort was expended to determine whether structural damage had occurred to the lift fans and J85 engines (see Section B for details of the airframe investigation). Besides loss of instrumentation and insulation damage, no structural damage was experienced.

It was determined that the J85 overtemperature was probably the result of hot gas re-ingestion during low speed operation. Fan exhaust was drawn into the engine inlets causing the exhaust temperatures to rise above the allowable limits. The XV-5A operating procedures were revised to limit fan mode operation to 70% J85 engine RPM and above. At this engine speed, re-ingestion effects are substantially reduced plus the aircraft cooling system operates effectively under static conditions.

By the end of the reporting period, the propulsion system had been operated successfully in both fan and conventional mode, under single and two engine operation, up to 100% power conditions.

B. GROUND RESONANCE TEST

Analysis continues in process on fan and engine data recorded during the aircraft ground resonance tests. This detail analysis should be completed during the next reporting period.

C. PROPULSION SYSTEM MAINTENANCE

Propulsion system maintenance support was provided during the aircraft ground tests at the Ryan Aeronautical Company, San Diego. This support included such effort as (1) installation of additional insulation and seals to the pitch fans in both aircraft to eliminate hot gas leakage; (2) readjustment of diverter valve doors to reduce gas leakage; (3) correction of fuel and lubrication leaks; (4) repair of instrumentation; (5) adjustment of fan scroll areas to obtain rated J85 exhaust gas temperature; and (6) calibration and adjustment of the fan overspeed control.

D. FULL SCALE WIND TUNNEL TESTS

During this reporting period, progress in the following areas in planning for the full scale wind tunnel test of AC #1 have been completed.

1. Full Scale Wind Tunnel Test Program
   Report Number 135 was completed in December 1963 and outlines the basic test program to be performed at the Full Scale Wind Tunnel Facilities of NASA-Ames. A test program of approximately 30 hours duration is presented, covering all phases of operation from hover to low speed conventional flight, with particular emphasis on the transition and conversion modes of operation.
2. All test hardware design and manufacture was completed in preparation for receipt of the aircraft at the test site.
3. The instrumentation and data recording system design and manufacture was completed and all recording systems have undergone bench checks to verify satisfactory calibrations and accuracy. Figures 3 and 4 show photographs of the data system as set up for laboratory checkout. This system includes a high speed digital

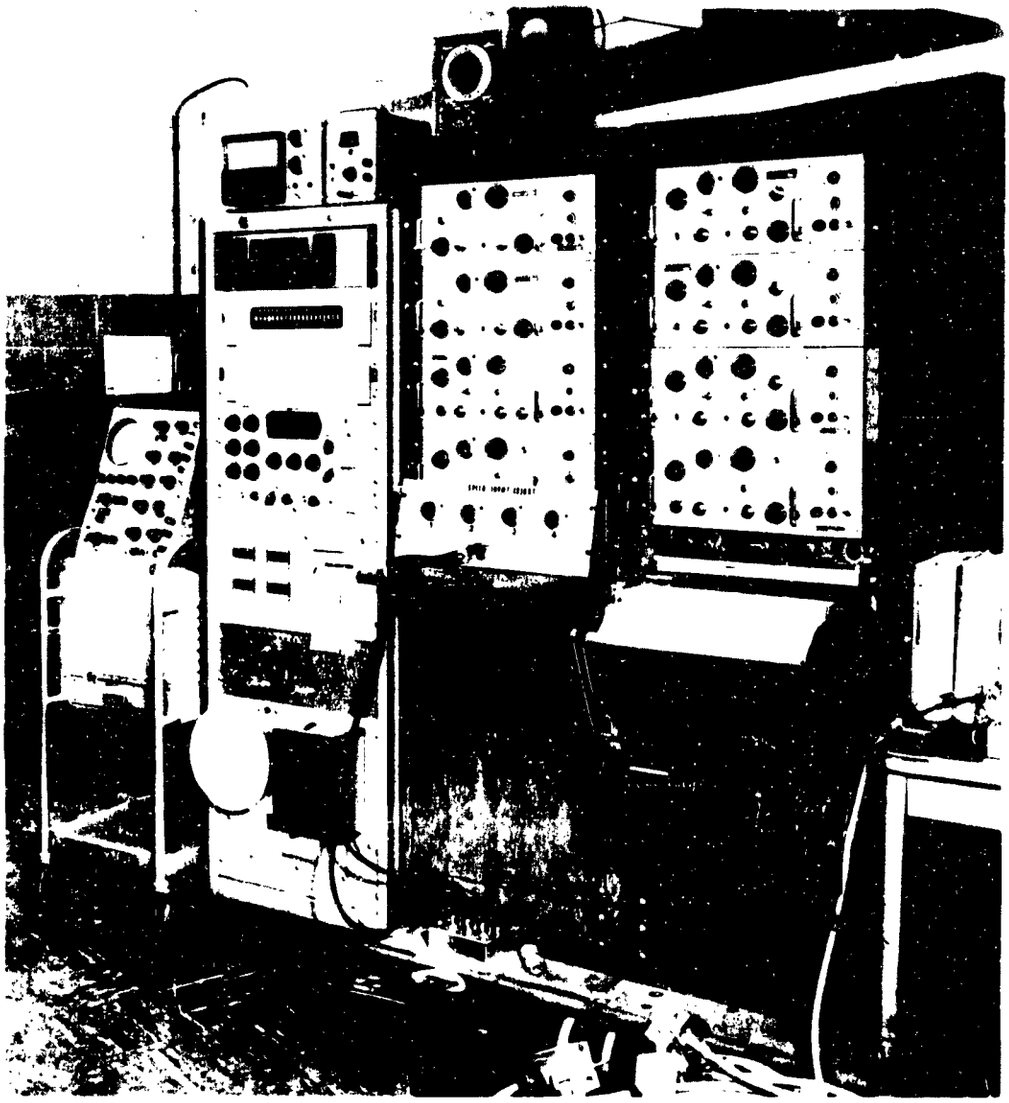

Figure 3. XV-5A Ames Instrumentation

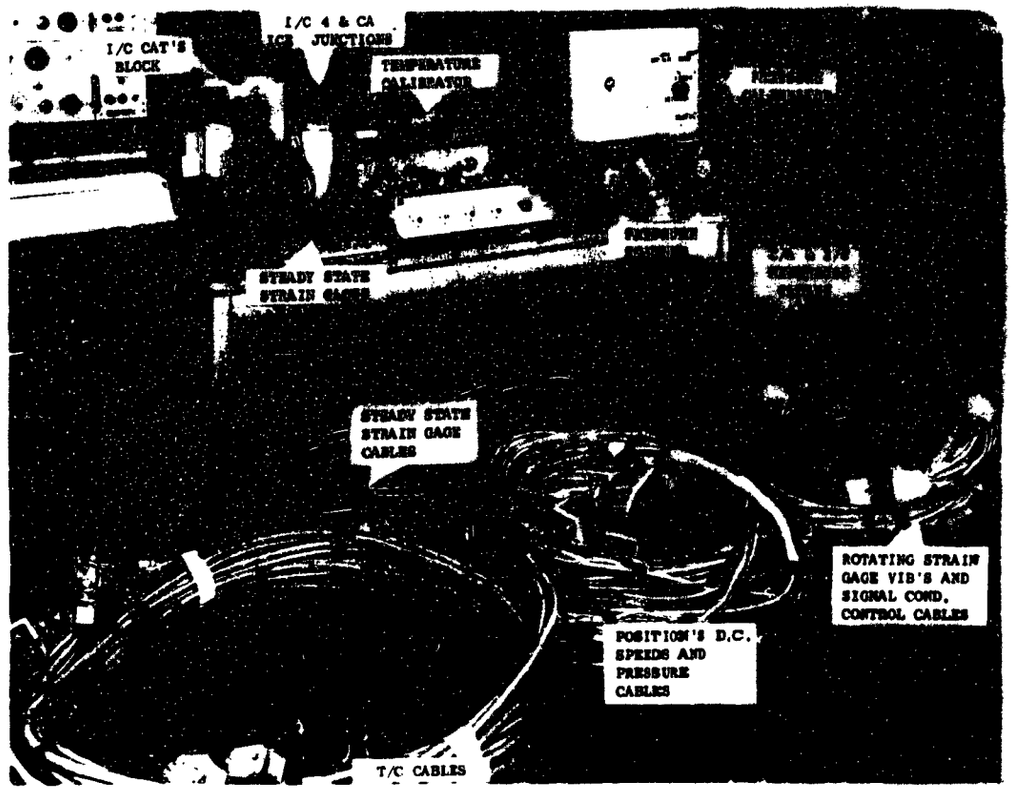

Figure 4. XV-5A Ames Instrumentation

recorder, an eight channel Sanborn recorder, cabling for hook-up to the aircraft (150 ft. in length), and necessary control and calibration equipment. The system has the capability of recording/monitoring all types of instrumentation signals generated in the aircraft with the exception of fan vibratory stresses. These will be monitored and recorded on a 12 channel system already set up at the test site from previous fan tests in the wind tunnel.

4. Data reduction programs using electronic computing machines have been written for processing of all test data anticipated during conduct of the tests. The inputs to these programs are obtained from the punched tape system incorporated in the digital system and the punched card system of the wind tunnel force balance system. The reduction programs are set up to process this data into usable engineering units and coefficients for ease of evaluation and analysis.

V. FLIGHT TEST SUPPORT

A. INSTRUMENTATION

A functional checkout was made of the second PCM set, The test indicated the set was acceptable for flight test. This test was performed on the PCM unit after the modifications were completed to make use of the temperature commutating system.

B. SUPPORT

Flight test mechanics, who will support the XV-5A propulsion system during the flight test phase, were used to support the aircraft ground tests at San Diego. Thus, experienced personnel for both the J85 engine and fans will be available at the Edwards Flight Test Center.

Initial contacts were made with the U.S. Air Force to establish definition of the available facilities, services, and support.

VI. MILESTONES

Number	Milestone	Planned Date	Actual Date	Anticipated Date
15A	Government acceptance of lift fan (5003)	Dec. 15		April 2?
31	Instrument and prepare for shipment pitch fan (PF001)	Dec. 16	Dec. 16	
38	Complete preparation of full scale wind tunnel test plan	Dec. 20	Dec. 20	
26	Instrument and prepare for shipment lift fan (5003)	Dec. 30		April 30